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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/812,731	03/30/2004	Choong-Chin Liew	4231/2055P	4547

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PALMER & DODGE, LLP
KATHLEEN M. WILLIAMS
111 HUNTINGTON AVENUE
BOSTON, MA 02199

EXAMINER	
SWITZER, JULIET CAROLINE	
ART UNIT	PAPER NUMBER
1634	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	03/30/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/812,731	LIEW, CHOONG-CHIN	
	Examiner	Art Unit	
	Juliet C. Switzer	1634	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 January 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *61-69* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *61-69* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *10/11/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. Applicant's election without traverse of Group I, further electing the marker BTG2 in the reply filed on 1/3/07 is acknowledged. Claims 61-69 are pending and examined in this office action.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 63, 64, 65, 66, 67, and 68 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The recitation "unfractionated samples of lysed blood" in claim 63 is unclear in light of the prosecution history in this application and in the parent applications from which this application claims priority. Claims 64-68 depend from claim 63 and are indefinite for this same recitation. The specification does not define what is meant by an "unfractionated samples of lysed blood." On its face, such a limitation appears to mean that the whole blood sample is not separated into constituent parts, however, interpretation of the claim in light of the specification, pending claims, and applicant's remarks filed with the amendment results in ambiguity with regard to the meaning of this claim limitation.

An example in the specification which discusses lysis prior to quantification includes a centrifugation step after which the "pellet" is further treated. This is a fractionation after lysis but before quantification.

One might interpret detecting in "unfractionated sample of lysed blood" as requiring that the detection occur relative to RNA that was extracted from the entire blood sample without any prior separation into parts, which could be accomplished by direct extraction of the whole blood without separating removing the plasma from the blood sample, for example.

Applicant set forth still a different definition for a similar claim limitation in the remarks filed introducing a similar phrase into the claims in the parent application 10/268730. In discussing basis in the specification for the limitation, applicant stated that the limitation refers to "a sample of whole blood which has not been fractionated into cell populations and includes a drop of blood (see remarks dated 4/25/05, at page 5)." This definition for unfractionated sample of whole blood set forth by applicant would, therefore, allow a fractionation of the cellular material prior to RNA extraction (as exemplified in the instant specification in Example 5).

And so it is unclear what the metes and bounds of the phrase "unfractionated sample of lysed blood" actually encompasses in light of the lack of definition of the phrase in the specification and the many, conflicting possible interpretations in light of the specification, pending claims, and remarks by applicant.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. Claims 63, 64, 65, 66, 67, and 68 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter

which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The limitation "unfractionated samples of lysed blood" appears to be new matter. The amendment which added this limitation did not cite support for the limitation. The specification teaches at page 43 treating a sample with lysing buffer, centrifuging the sample, and then processing the pellet with RT-PCR (Example 5). Thus, the sample was fractionated prior to quantifying. The examiner was not able to identify basis for this limitation in the specification.

6. Claims 61-69 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Nature of the invention

The invention is drawn to a method detecting schizophrenia in a human test subject. The claims all include a step of determining the level RNA encoded by the gene BTG family, member2 (BTG2) in a blood sample obtained from said human and comparing the level with the level of control RNA encoded by said gene in RNA of blood samples from control subjects, and wherein said comparison is indicative of schizophrenia in said human test subject. Thus, the independent claim, as written, states that a comparison of a human test subject BTG2RNA level in a blood sample to a control indicates that schizophrenia is present in the test subject. The nature of the invention requires the knowledge of a reliable association between comparing

BTG2 expression and the indication that schizophrenia is present in a human. Further, the practice of the invention requires an understanding of how the presence of schizophrenia effects the level of BTG2 expression in human blood in patients having schizophrenia versus patients that do not have schizophrenia but may have some other disorders.

Scope of the claims

The claims are extremely broad because they require set forth that any or all comparison between a test subject and RNA level from "control subjects" is indicative of disease. The claims are broad with regard to whether or not the comparison requires identifying a difference in expression or not, and if a difference is detected whether that is an increase in RNA levels or a decrease in RNA levels. The claims are broad with regard to the "control subjects" would could encompass patients with schizophrenia, healthy patients, patients with some other disease, such as depression or rheumatoid arthritis or multiple sclerosis, and set forth that the comparison alone is sufficient to indicate schizophrenia, no matter the result of the comparison. Later claims further define the control subject and require a statistically significant difference or similarity in RNA levels between control subjects and test subject, but even these claims do not set forth the direction of the difference necessary to indicate schizophrenia. The claims are very broad in scope because they encompass that ANY level and direction of difference in gene expression between the tested subjects is indicative of disease. That is, the claims do not set forth that one level should be higher or lower than the other, and further do not set forth how much of a "difference" between two individuals would be necessary to draw the conclusions set forth in the claims.

Teachings in the Specification/Examples

Regarding schizophrenia, the specification provides example 27 wherein gene expression profiles of blood samples from individuals having schizophrenia were compared with normal individuals, that is healthy patients. The specification teaches that 1,952 genes were identified as being differentially expressed, and regarding the instant claims, table 3Y provides a list of these genes (Example 27). BTG2 is among the genes.

Table 3Y teaches that the ratio of expression in schizophrenic samples relative to control samples is 2.46, indicating that in the tested samples, BTG2 was expressed, on average at a 2.46 times higher level in schizophrenic patients versus healthy controls. Table 3Y teaches that this result is significant p=0.0076.

The specification further provides example 51 which compares gene expression in patients having schizophrenia versus patients having manic depression syndrome. The specification teaches that 294 genes were identified as being differentially expressed, and regarding the instant claims, table 3AC provides a list of these genes (Example 51). BTG2 is among the genes. The table teaches that there is a p-value of 0.0013 for BTG2 expression, but the specification does not provide any guidance as to the level of "difference" between expression in the two populations, nor does the specification provide any guidance as to the direction of the difference (higher or lower expression) that is expected to be observed for any single pairing of samples.

The claims suggest that detecting and comparing expression of BTG2 in a test patient versus any possible set of control patients alone is sufficient to indicate the presence of schizophrenia (that is detect schizophrenia). The plain language of the claims suggests that any

comparison between a test subject and control subjects, even as few as two control subjects, is sufficient to conclude that schizophrenia is detected.

The claims provide data to support the assertion in the claims- namely that comparison of the BTG2 expression level in a test sample to control subjects (any control subjects) is sufficient to detect schizophrenia in a test patient. Claim 66 is limited to a case where the control subjects do not have schizophrenia, but they could still have any other possible disease or condition. For example, the claims are inclusive of control subjects that have manic depression syndrome. For this embodiment of the claims, the specification does not provide information about an essential aspect of the invention, namely, the nature of the difference in expression that was observed between schizophrenia patients and manic depression syndrome patients.

Furthermore, though the specification teaches that this gene is differentially expressed in schizophrenia patients versus healthy patients, the specification teaches this is true for thousands of genes. There is no guidance or analysis of data in the specification to suggest that this gene in particular is sufficient to conclude that schizophrenia is present in a sample, as is instantly claimed. This information is essential to understanding and practicing the claimed invention because it is critical to knowing how to interpret a particular comparison result.

State of the Prior Art and Level of Unpredictability

Observing differences in expression between two populations is a highly unpredictable endeavor. While the instant specification teaches that BTG2 is differentially expressed in a population of schizophrenia patients versus control subjects, and even in a population of schizophrenia patients and manic depression disorder subjects, the specification does not establish that any particular level of expression of BTG2 (relative level or raw level) is sufficient

to DETECT schizophrenia to the exclusion of other disorders, which is encompassed by the instant claims, and indeed, suggested by the instant claims.

Dangond et al. (US 2004/0018522) teach that BTG2 is differentially expressed in blood of patients with MS versus a group of controls that included healthy patients and patients with ALS (See examples, Tables 3, 6, 8, and 10). Pittman et al. teach that BTG2 is upregulated 2.15 fold in the blood of patients with rheumatoid arthritis versus healthy controls. These diseases are very different from schizophrenia, yet they display a similar expression phenotype- that is upregulation of BTG2 in blood samples from patients with illness versus healthy controls. This exemplifies that it is highly unpredictable whether or not one can conclude, simply from a blood sample of a test patient, that schizophrenia is present, since increased expression of the gene in blood could indicate some other disorder or phenotype is present, whether that is MS, rheumatoid arthritis or some other disease which has not yet been analyzed.

Iwamoto et al. teach that expression profiling in psychiatric fields have been notoriously discordant, with different studies often reporting conflicting gene expression data (The Neuroscientist, Vol. 12, Number 4, 2006, pages 349-361; Abstract and page 351). Tsuang et al. undertake an analysis that is very similar to the one in the instant specification. Regarding their results, Tsuang et al. caution that the results must be interpreted with caution given several limitations including small sample size, the fact that the findings are not replicated in a separate cohort and results "may represent chance findings and type-I inferential errors," and that the patients tested were all on drugs that were not accounted for in the analysis (American Journal of Medical Genetics, Part B (Neuropsychiatric Genetics) 133B:1-5(2005)). All of these cautions set forth by Tsuang et al. appear to be equally relevant to the study set forth in the instant

application. Vawter et al. teach that there is lack of consistency in the study of genes differentially expressed in schizophrenia which might be related to etiological and genetic heterogeneity of the illness (p. 42, Vawter et al. Schizophrenia Research, Vol. 67, pages 41-52, 2004). Further, Vawter et al. teach that genes that are significant by a t-test may not exceed the threshold for fold of change to be considered above background expression (p. 46). All of these taken together underscore and highlight the very unpredictable nature of this technology area.

Furthermore, although BTG2 was not observed to be differentially expressed in any of the other examples in this specification, it is unknown and unpredictable whether it would be expressed in the blood of patients having other mental illnesses or any other diseases which were not tested in the instant specification or diseases which were tested in the instant specification but in a different population of test subjects, and whether this expression would be different from levels of expression in healthy controls. It is unpredictable whether the gene is differentially expressed, for example, in patients having manic depression disorder versus healthy controls, and if it is, how this relates to the difference in expression between patients with schizophrenia and manic depression disorder. A method for detection which relies on a comparison between expression in the blood of a test subject and control subjects requires the knowledge of this information in order to reliably "detect" schizophrenia, as set forth in the claims. The instant specification has not established that all difference, no matter the magnitude nor the direction, relative to any control subjects or even relative to a healthy control subject is indicative of schizophrenia. Furthermore, the specification has not shown that all expression at a level statistically the same as o that observed in a population of patients having schizophrenia is sufficient to conclude that schizophrenia is present, as set forth in claim 67. In fact, as

previously noted, Pittman et al. and Dangond et al. observed that this gene is over expressed in different diseases with highly dissimilar etiologies. It is entirely unpredictable if this is also the case with other diseases. It is not known under what circumstances the result observed in the instantly examined control and test populations would be repeatable, as the results have not been validated. But even if one were to obtain the same result in a comparison to patients with manic depression syndrome, for example, it would be unknown because applicant did not disclose the magnitude of difference in expression between schizophrenic populations and manic depression populations, nor did applicant disclose the direction of variation. All of these inquiries are particularly important in this case since the claims are silent as to which differential expression observations would be sufficient to detect the presence of schizophrenia.

Further, the claims of the instant application set forth the comparison of the gene expression in a single individual versus as few as two other individuals, and they set forth that a comparing gene expression between the two is "indicative of" schizophrenia. Neither the specification nor the claims set forth a threshold of difference between an individual's expression and the control expression of BTG2 in the blood that would be sufficient to conclude that the difference in gene expression between a test individual and any type control group is "indicative of" the recited schizophrenia. Because the claims encompass any level of altered gene expression, it is relevant to point out that the art of Cheung et al (2003) teaches that there is natural variation in gene expression among different individuals. The reference teaches an assessment of natural variation of gene expression in lymphoblastoid cells in humans, and analyzes the variation of expression data among individuals and within individuals (replicates) (p.422, last paragraph; Fig 1). The data indicates that, for example, expression of ACTG2 in 35

individuals varied by a factor of 17; and that in expression of the 40 genes with the highest variance ratios, the highest and lowest values differed by a factor of 2.4 or greater (Fig 3). It is thus unpredictable as to whether or not any level of altered gene expression is indicative of a schizophrenia or the absence of schizophrenia.

The unpredictability of correlating gene expression level to any phenotypic quality is taught in the post-filing art of Wu (2001). Wu teaches that gene expression data, such as microarray data, must be interpreted in the context of other biological knowledge, involving various types of 'post genomics' informatics, including gene networks, gene pathways, and gene ontologies (p.53, left col.). The reference indicates that many factors may be influential to the outcome of data analysis, and teaches that expression data can be interpreted in many ways. The conclusions that can be drawn from a given set of data depend heavily on the particular choice of data analysis. Much of the data analysis depends on such low-level considerations as normalization and such basic assumptions as normality (p.63 - Discussion). The art of Newton et al (2001) further teaches the difficulty in applying gene expression results. Newton et al. teaches that a basic statistical problem is determining when the measured differential expression is likely to reflect a real biological shift in gene expression, and replication of data is critical to validation (p.38, third full paragraph). There is no replication of data in the instant specification.

Quantity of Experimentation

The instant specification does not provide enabling support for the practice of a single embodiment within the claimed invention since the claimed invention results in the detection of schizophrenia. In particular, the specification does not provide adequate guidance to appraise one of ordinary skill in the art as to what levels of BTG2 gene expression must be observed to

successfully conclude that schizophrenia is present. Further, although the specification teaches there are differences in BTG2 levels in a schizophrenia population versus a control patient population, and the specification teaches that for this population the difference is a 2.46 fold increase, the specification does not support the assertion in the claims that observing such an increase relative to any and all control populations of 2 or more individual is sufficient to "detect" schizophrenia. Thus, given the lack of teaching in the specification and the highly unpredictable nature of the technology, an extensive amount of work would be required to practice the claimed invention.

In order to practice the claimed invention, one would have to undertake an extensive amount of experimentation in a highly unpredictable technology area. One would have to begin by validating the results observed in the instant specification in a separate population of healthy and schizophrenic patients, in view of the established level of unpredictability in this technology area. One would have to further complete similar analysis for other diseases and conditions and control populations versus healthy controls and versus schizophrenic controls in order to attempt to establish when and if analysis of BTG2 expression is sufficient to conclusively detect schizophrenia. For example, consider the comparison of a test result and a control population of individuals with manic depression How different from the average level of expression of healthy individuals would the test result have to be to indicate schizophrenia? Would any difference, up or down regulation be indicative of schizophrenia? Or could one result indicate schizophrenia and one a different disease such as MS or RA? Is BTG2 expressed in the blood of individuals with a disease other than schizophrenia, manic depression disorder, rheumatoid arthritis, and multiple sclerosis? Is this expression also diagnostic of other mental illnesses or other disorders

entirely unrelated to schizophrenia? In order to reliably use a method for detecting schizophrenia, one would first have to answer at least these questions. One would also, however, have to carry out this testing for validation, for it is possible that the result observed in the instant specification is intrinsic to the cohort of patients evaluated in applicant's study. Further, one would have to undertake experimentation to determine difference thresholds required to determine that a patient has or does not have a disease.

As discussed, this art area is highly unpredictable.

Conclusion

The claims include methods which encompass the detection in blood of the expression of BTG2 in a test subject and comparing this expression to control subjects, wherein the comparison itself "is indicative of schizophrenia." The identification of gene differential expression/disease indication relationships is a highly unpredictable endeavor, requiring extensive experimentation. The specification provides minimal guidance. In light of the factors discussed, therefore, it is concluded that it would require undue experimentation to practice the claimed invention.

Conclusion

7. No claim is allowed.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Juliet C Switzer whose telephone number is (571) 272-0753. The examiner can normally be reached on Monday, Tuesday, or Thursday, from 9:00 AM until 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Ram Shukla can be reached by calling (571) 272-0735.

The fax phone numbers for the organization where this application or proceeding is assigned are (571) 273-8300. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (571)272-0507.

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For all other customer support, please call the USPTO Call Center (UCC) at 800-786-9199.

Juliet C. Switzer
Primary Examiner
Art Unit 1634

March 26, 2007